

**CELL STRUCTURE AND FUNCTION**  
**Pre-AP Seventh Grade Science**  
**2011-2012**

**Description**

All living organisms are made of cells. A cell is the smallest unit able to perform life functions. All cells come from pre-existing cells through processes of cell division. When cells divide, the hereditary information they contain, DNA, is passed from cell to cell. All cells, plant and animal, have basically the same composition, and carry out many of the same chemical reactions, although both plants and animals have organelles that are unique. Energy flow occurs within cells allowing life processes to be carried out. Cells may be either prokaryotic or eukaryotic. Prokaryotic cells do not contain a nucleus or many organelles, while eukaryotic cells do. Molecules, including carbohydrates, lipids, proteins, and nucleic acids, enter and exit a cell by osmosis and diffusion. In eukaryotic cells, these molecules join together to form structures within the cell called organelles, each of which is responsible for cellular functions. Important organelles include cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, and vacuole. Each cell consists of body of jelly-like cytoplasm surrounded by a cell membrane. The organelles are suspended within the cytoplasm. In most multi-cellular organisms, cells associate to form tissues, tissues are arranged into functional structures called organs, coordinated groups of tissues and organs carry out major biological functions and are called organ systems, and organ systems make up the complex multi-cellular organism. Cellular processes can affect the behavior of an organism, such a plant wilting from low turgor pressure, and behavioral changes in both plants and animals resulting from hormonal changes. Emphasis is placed on microscopic observation of different cell types and their unique functions, as well on cells of different sizes. Emphasis is also placed on comparing the cell cycles of different types of cells and on cell differentiation and growth.

**Connections**

Cells are the smallest units of life. Many functions that occur inside the cell are similar to functions of larger systems within an organism. In addition, energy transfer as well as physical and chemical changes occur in the living cell as well as in non-living structures. Energy transfer is discussed for nonliving structures in a previous unit. Physical and chemical changes, including the breakdown of larger particles into smaller particles during digestion, will be examined in relation to human body systems in a later unit. Cells are specialized, and may differ in their processes depending on their specific function in the same way that physicians or teachers specialize in a specific area. Parts of a cell are interdependent, and the cell cannot function if all parts are not working properly; a real-world analogy might be that humans could not properly digest food without a stomach, and an animal cell could not digest food particles without lysosomes.

**Enduring Understandings**

1. Cells are the smallest unit that can carry out life processes, and only come from other cells.
2. Cells are part of the hierarchical organization of living organisms: cells make up tissues, tissues make up organs; tissues and organs make up organ systems, and organ systems make up organisms.
3. Cells may be classified as prokaryotic or eukaryotic and differ in their organelles and reproductive processes.
4. Plant and animal cells have similar structures necessary to carry out cellular functions, including cell membrane, nucleus, cytoplasm, mitochondrion, and vacuole.
5. Although plant and animal cells have many of the same structures, they have unique differences. Plant cells contain cell walls and chloroplasts which animal cells do not have, and animal cells contain lysosomes and centrioles which plant cells do not contain.

6. Cellular organelles carry out specific functions for the cell, much like organs carry out specific functions for the organism. For example, the correct disposal of waste is essential for daily life; this also applies at the cellular level.
7. Cellular activity transforms energy needed for life processes.
8. Materials necessary for production of energy passively enter the cell through processes like diffusion and osmosis.
9. Internal cellular processes are sometimes externally visible. For example, when a plant does not have enough water in its vacuoles, turgor pressure drops and the plant wilts, and when plant hormones accumulate, tropisms occur.
10. Cells are specialized for specific functions, and therefore have varying cell cycles, appearances, and structures.
11. Cellular differentiation must occur in order for a fertilized cell to become a functioning organism. Differentiation is the process that takes place inside an embryo that determines which genes are expressed and hence what type of cell will result.

### **Essential Questions**

1. How did cell theory develop and who were the major contributors?
2. What are the components of modern cell theory?
3. Beginning with the cell, how are living things organized?
4. What are the internal structures of plant and animal cells, and how are they different?
5. What are the functions of cell organelles?
6. How is energy transferred during cellular processes?
7. How are cellular differentiation and cellular specialization related?
8. How do materials necessary for cell functioning enter and exit the cell?
9. How do internal cellular processes show externally?
10. What makes cell structures interdependent?
11. How do cells become specialized for specific tasks within an organism?
12. How are cell division processes among organisms alike or different?
13. How is cellular waste disposal similar to waste disposal of an entire organism?
14. Are all cells the same size?

### **Essential Concepts and Skills**

By the end of the unit, the student is expected to:

1. critique early cell theory and explain how it has been improved upon over time
2. generate a flow chart showing life organization, beginning with the cell
3. diagram and describe the function of internal cellular structures, including cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, and vacuole
4. compare and contrast how energy is transferred during cellular processes in different organisms like plants, fungi, protists, and animals
5. based on microscopic evidence, create a scale model showing the relative sizes of molecules, bacteria, animal cells, and viruses.
6. use a microscope to help identify and describe structure and function of amoebae, fungi, plant roots, plant leaves, animal muscle cells, and animal skin.
7. explain how cellular differentiation leads to specialized cells
8. use a microscope to distinguish between different cellular structures, including molecules, bacteria, animal cells, and viruses
9. model diffusion and osmosis
10. distinguish between cells that divide, cells that do not divide, and cells that only divide in very special circumstances
11. explain the effects that cellular processes have on varying turgor pressure and accumulation of hormones in a plant

12. create an analogy to portray how cell functions are dependent on each other's success
13. portray how cellular functions are similar to functions of the larger organism such as waste disposal
14. compare and contrast the cell cycles, including cell division, of different types of cells, both prokaryotic and eukaryotic, such as fungi cells, cells found in plant leaf, nerve cells, skin cells, muscle cells, and/or plant root cells

#### **What do students typically have as misconceptions?**

1. Cells are the components of many things including carbohydrates and proteins
2. Living things grow because their cells get larger.
3. There are only two kinds of cells - plant and animal.
4. All cells have nuclei.
5. Cells are inside the human body, rather than the human body is itself composed of cells.

#### **Preconception Survey**

1. How do living things grow?
2. What do all cells have in common?
3. How are cells related to the human body?

#### **Formative Assessment Items**

1. Use a microscope to identify different types of cells and their functions
2. Make a flow chart to show the organization of living things from cell to organism
3. Diagram, compare, and contrast different types of cells, including at least one single-celled organism
4. Sketch a picture of a common cell and its organelles and describe what each organelle does
5. Model the difference between diffusion and osmosis
6. Illustrate scenarios that are analogous to processes that are carried out within the cell

#### **TEKS Covered**

**7.7 Force, motion, and energy.** The student knows that there is a relationship among force, motion, and energy. The student is expected to:

B) illustrate the transformation of energy within an organism such as the transfer from chemical energy to heat and thermal energy in digestion.

C) demonstrate and illustrate forces that affect motion in everyday life such as emergence of seedlings, turgor pressure, and geotropism.

**7.12 Organisms and environments.** The student knows that living systems at all levels of organization demonstrate the complementary nature of structure and function. The student is expected to:

C) recognize levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms.

D) differentiate between structure and function in plant and animal cell organelles, including cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, and vacuole.

#### ***Supporting Standard-Category 4***

E) compare the functions of a cell to the functions of organisms such as waste removal.

F) recognize that according to cell theory all organisms are composed of cells and cells carry on similar functions such as extracting energy from food to sustain life. **Supporting Standard-Category 4**

**6.12 Organisms and environments.** The student knows that all organisms are classified into Domains and Kingdoms. Organisms within these taxonomic groups share similar characteristics which allow them to interact with the living and nonliving parts of their ecosystem. The student is expected to:

D) identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction, that further classify them in the currently recognized Kingdoms. **Supporting Standard-Category 4**

### **College Board Standards Covered**

**LSM-PE.2.1.2** Gather data, based on observations of cell functions made using a microscope or on cell descriptions obtained from print material, that can be used as evidence to support the claim that there are a variety of cell types.

**LSM-PE.2.1.3** Compare and contrast, using evidence of different cells and essential life functions, the various processes different cells (e.g., plant, fungi, protist, animal) use to accomplish the same life function (e.g., growing, obtaining energy).

**LSM-PE.2.1.4** Construct a scaled model, based on measurements and estimates made using a microscope (when possible), that represents the relative sizes of a molecule, a bacterial cell, an animal cell and a virus.

**LSM-PE.2.2.1** Describe, based on observations of cells made using a microscope and on information gathered from print and electronic resources, the internal structures (and the functions of these structures) of different cell types (e.g., amoeba, fungi, plant root, plant leaf, animal muscle, animal skin).

**LSM-PE.2.2.2** Construct an analogical model (analogy) of the interaction of the internal components of a cell (e.g., working parts of a city, factory or automobile). Predict and justify, using the model, the impact on the cell or on the organism if one of the components fails to function properly.

**LSM-PE.2.2.3** Observe patterns in the concentration of molecules of a solution (e.g., dye in water, tea) or across a membrane. Construct a model of the observed patterns.

**LSM-PE.2.2.4** Predict **problems** that may arise when certain essential molecules cannot enter a cell. Justification is based on the function of the cell membrane and the role of these molecules in carrying out the essential life functions that take place within a cell.

**LSM-PE.2.3.1** Give examples of cell types that divide, cell types that do not divide at all, and cell types that divide only under very unusual circumstances.

**LSM-PE.2.3.2** Organize and represent information gathered from print and electronic resources to compare the cell cycles of several cell types that undergo cell division. Representation(s) include

the frequency of division, the typical duration of the cell cycle, the specialized function of the cell, and any special conditions that stimulate cell division and cell death. Make a claim about, and justify the relationship between, characteristics of cell cycles and the function of the cell.

*[BOUNDARY: Types of cells appropriate for grades 6–8 could include fungi, plant leaf, nerve, skin, muscle and plant root.]*

**LSM-PE.2.4.1** Observe and document the development of an organism (e.g., sea urchin). Construct a representation, using appropriate time scale, of the sequence of general stages of cell differentiation that begins immediately after fertilization and ends with the development of a simple multicellular organism. Representation includes major milestones of cell differentiation and growth.

*[BOUNDARY: Students do not need to know terms (e.g., cleavage, blastula, gastrula) that identify specific stages.]*

### **Vocabulary**

DNA, hereditary, carbohydrates, lipids, proteins, nucleic acids, organelles, cell, tissue, organ, organ system, organism, cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, vacuole, cytoplasm, lysosomes, centrioles, prokaryotic, eukaryotic, turgor pressure, hormone, tropism

